

ControlFire® User Manual

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Safety Precautions When Using ControlFire® Perf Unit

The following precautions must be followed when using the ControlFire® Perf Unit.

1. Do NOT open the unit and try and service. If any service or repair is required the unit must be returned to the manufacturer, Hunting Titan.
2. Always use the recommended AC power cord that includes a 3rd wire safety ground that connects equipment to a grounded single phase outlet.
3. When installing into a wireline truck always position the ControlFire® Perf Unit so that the AC cord can be accessible for rapid disconnect.
4. When replacing either the AC fuse or W/L fuse always use the exact replacement P/N.
5. If equipment is not used in a manner specified by the manufacturer, safety protection may become impaired

Safety Symbol Explanation



Caution: Risk of danger, refer to user guide.



Warning: Electrical shock hazard.

1.0 Equipment Overview

The minimum equipment required for running a ControlFire® switch system is listed.

Item	Equipment Description	P/N
1	ControlFire® Command & Control Panel	9002-013-510
2	Cable Kit	9002-013-017
3	Wireline Switch Simulator Panel	9002-013-610
4	ControlFire® Perforating Switch Rev 1.8 PCB 1.0D	9002-013-120-1.8
5	Wireline Switch Simulator Panel External Test Block	9002-013-320

¹Items 3 and 5 can be used for system verification at the shop or on a job location

- **ControlFire® Perforating Command and Control Panel** – Shown in Figure 1 is a surface control panel that provides communication and control to the downhole ControlFire® switch string. This control panel interfaces with a PC or Laptop via a “USB connector”, connects to a Shooting Power Supply through the “Shooting PWR In” connector and to a wireline cable via the “Wire Line Output” connector. The Perforating Command and Control Panel is available as a portable panel, rack mount panel or integrated into a shooting power supply as a combination rack mount panel. See Section 10 for part numbers.



Figure 1

- **Cable Kit** – Shown in Figure 2 are the normally required cables and connectors. An itemized listing is given:



Figure 2

1. AC Input Power Cord – Three wire power cord for connecting the Control Panel to an AC power source (hot, natural and safety ground). The safety ground (3rd wire) within the AC receptacle must be connected to earth ground. Ground wire must be Green/Yellow. Cord should be:
3-Conductor, 18AWG, 10A, 60°C minimum, 3m length maximum
2. Shooting PWR In Cable - RG8 Coaxial Cable, 10 feet long, with Cannon Female Plug and Male UHF PL-259 connectors
3. Wire Line Output Cable - RG8 Coaxial Cable, 10 feet long, with Cannon Male Plug and Male UHF PL-259 connectors
4. Double Female UHF adaptor – Used to convert the Male UHF of the Wire cable to a female gender
5. USB cable – Male to Male cable used to interface a PC or Laptop to the Control Panel
6. Line Output Test Cable and (1) UHF Female to double banana pin connector to plug into the WL Switch Simulator

- **Perf Switch and Wireline Simulator Panel** – Shown in Figure 3 is a Perf Switch Simulator that allows the user to perform demonstration, training exercises, and troubleshoot/verify wireline interconnections at the well site.

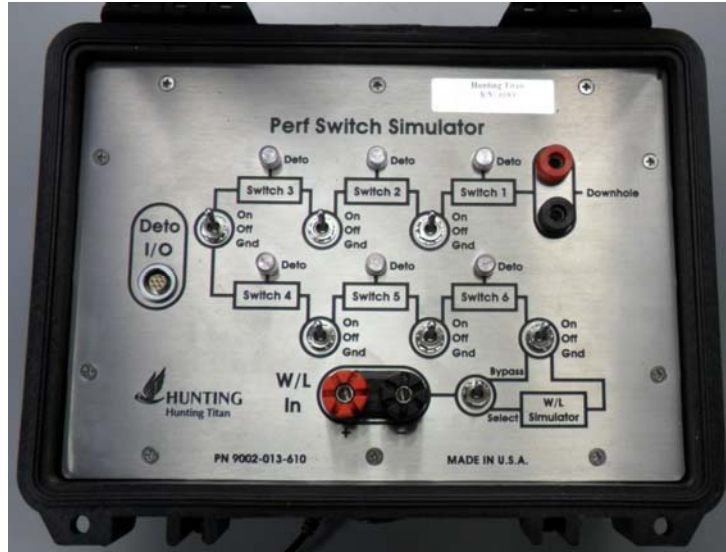


Figure 3

- **Wireline Switch Simulator Panel External Test Block** – Shown in Figure 4 is a connector block with a cable that plugs into the Perf Switch Simulator, Deto I/O interface. This assembly provides the user a means to connect resistors to each of the 6 Perf Switches inside of the Perf Switch Simulator for the purpose of simulating a detonator firing. This concept can be used for demonstration, training and troubleshooting wireline problems on a job site.

DO NOT CONNECT LIVE DETONATORS!

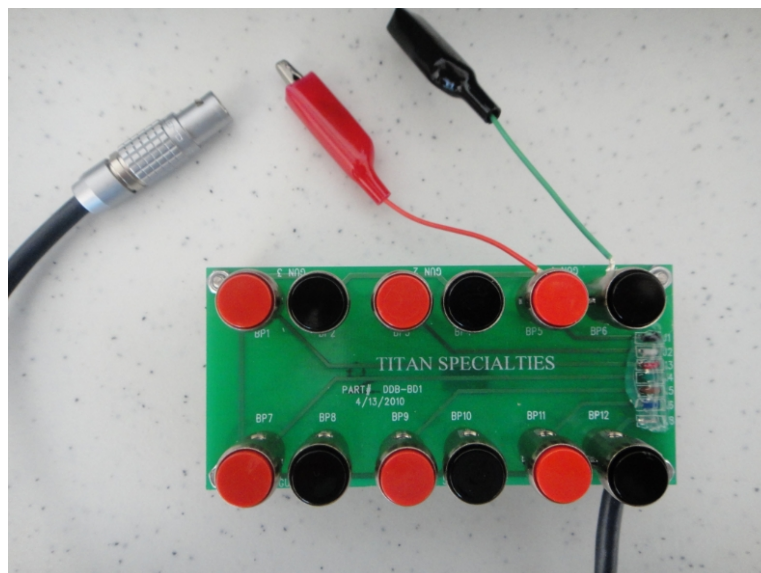


Figure 4

- **ControlFire® Switch Rev 1.8** – Shown in Figure 5 is an expendable ControlFire® Perf Switch. Every gun/plug in a tool string must be equipped with a Perf Switch. Each switch can be verified, armed, selectively fired or skipped upon command from the surface. An RF-Safe ControlFire® Assembly is also available. See Section 10 for part numbers regarding the RF-Safe ControlFire® assembly options.
- (Note: ControlFire® switch body may be black shrink wrap or maroon plastic)



Figure 5

2.0 ControlFire® Perforating Panel and Switch Specifications

Table 1 gives the specifications for the ControlFire® Perforating Command and Control Panel. Table 2 shows the specifications for the ControlFire® switch.

Specification	Rating/Description	Conditions
Temperature	(-10 to +55)C (-14 to +131)F	Operating
	(-10 to +55)C (-14 to +131)F	Start Up
	(-30 to +75)C (-22 to +167)F	Storage
Humidity, RH%, Operating & Storage	10 to 95% RH	Non-Condensing
Altitude	0 – 10,000ft	Operating
	0 - 45,000ft	Storage
IEC60529 Rating	IP67 (1 meter submersion for 30 minutes)	
AC Input Voltage	120-220 VAC	0~100% load
Frequency, Range	50 – 60 Hz	0~100% load
Input Power	150W Max	
AC Power Cord	3 conductor, 18AWG, 10A, 60°C minimum, 3m length maximum	Operating
AC Entry Fuse	250V, 1.6A, 5mm X 20mm slow blow. Part# BK/GDC-1.6A	Operating
Wire Line Fuse	250V, 0.63A, 5mm X 20mm Slow blow. Part# BK/GDC-630MA	Operating

Table 1

ControlFire® Switch Specifications

ENVIRONMENTAL		
Operating Temperature Range		-20 °F (-29 °C) to 347 °F (175 °C)
Survival Temperature		-58 °F (-50 °C) to 392 °F (200 °C)
Max Thermal Change		42.8 °F (5 °C) / Minute
Vibration Compliant		Compliant to all hollow carrier gun systems
Vibration (3 axis)		50 g RMS @ Sweep Frequency 50-1000 Hz
ELECTRICAL		
Operating Voltage Range		-5 VDC to -550 VDC
Operating Current – Standby		>1mA
Current – Communicating		10mA at Surface 30mA Downhole
Max Firing Current		1A for 12 seconds; 1.5A for 5 seconds
Bi-directional Communications		Bi-directional
COMPATABILITY		
Detonators – Hot Wire		50 ohms or higher (single or double resistor types)
Igniters – Setting Tools		50 ohms or higher
RF Safe Detonators		CFA, PX-1/EBW, RED (all versions)

Table 2

3.0 Installing Software for ControlFire® Perforating Panel

The following procedure will provide a step-by-step guide for installing the ControlFire Perf Unit GUI and USB Virtual Com Port Driver onto a PC or laptop.

3.1 Installing GUI Program

Installation Steps:

1. Any previous versions of Titan Perf Unit must be uninstalled before attempting to install a newer version of the Titan Perf Unit program. Use the Add/Remove Program on the Control Panel and remove any previous existing version of Titan Perf Unit 4.
2. Download the “Setup PU5 V.5.5500.zip” file into the folder of your choice.
3. Unzip files. A sub-folder, “Setup PU5 V.5.5500”, will be created. Go to this folder.
4. Double click on “Setup PU5 V.5.5500.exe”.
5. If Microsoft .NET Framework 4 is not installed on PC/Laptop then a popup will appear asking to install.
6. When the “Welcome to the InstallShield Wizard for Hunting Titan Perf Unit 5” appears, click Next.



Figure 6

7. The License Agreement then appears. Read through the agreement and, if you agree, click the “I Agree” radio button. (Otherwise, if you do not agree, click Cancel.) Then click Next.
8. The Select Installation Folder appears next. Choose a Folder of your choice or use the default Folder. Click Next.

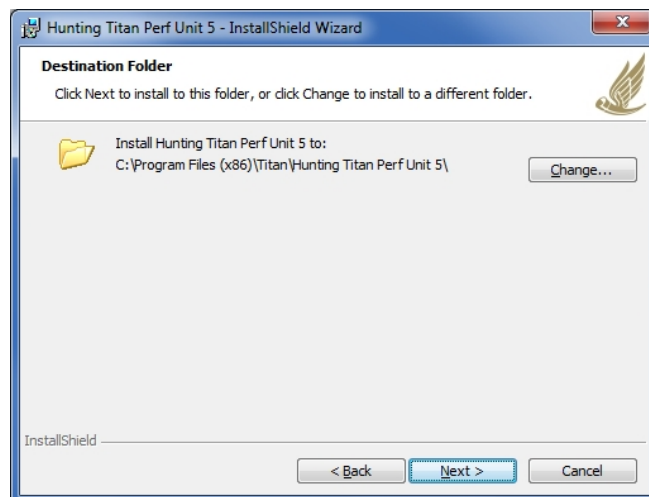


Figure 7

9. The “Ready to Install the Program” screen appears. Click Install as shown in Figure 8.

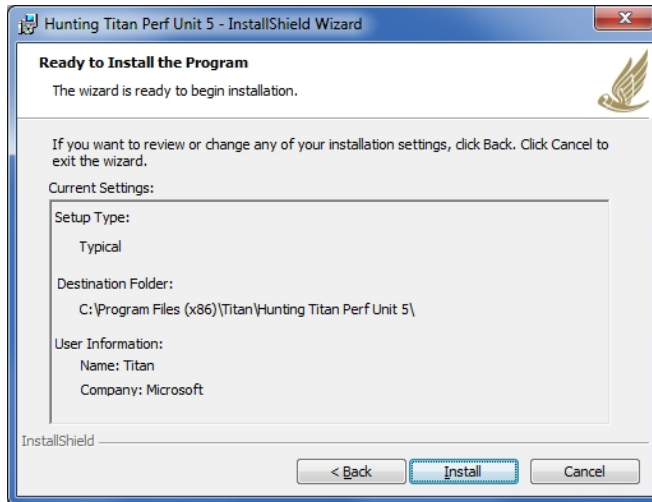


Figure 8

10. The “Installing Hunting Titan Perf Unit 5” screen appears, shown in Figure 9, and the program installs along with showing a progress window to completion.

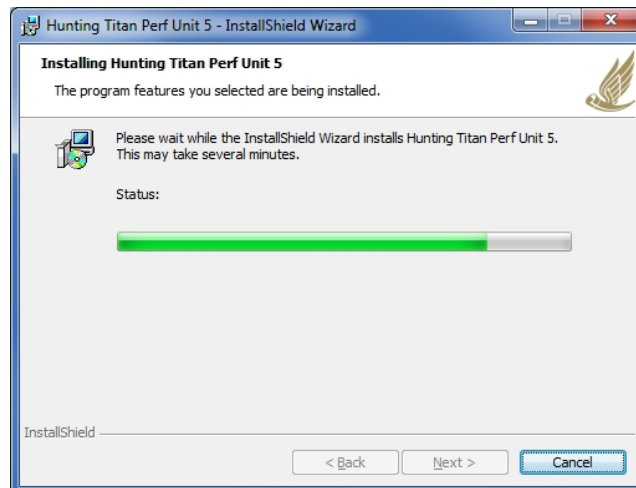


Figure 9

11. The “InstallShield Wizard Completed” window appears, shown in Figure 10, indicating a successful install. Closing the window completes the installation.



Figure 10

12. A “Hunting Titan PU5” icon appears on the desktop. See image in Figure 11. Double clicking on icon initiates the Perf Unit 5 program.



Figure 11

3.2 Installing USB Virtual Com Port Driver

The USB Virtual Com Port Driver may be needed to run the Hunting Titan Perf Unit 5 software. As a result of a successful install in section 2.0, an executable driver file was also copied onto the hard drive but not installed. The driver file is located at: C:\TitanData\CDM v2.10.00 WHQL Certified.exe. The driver is supplied by FTDI and can also be found at: <http://www.ftdichip.com/Drivers/VCP.htm> This driver support includes the following versions of the Windows operating system: Windows XP, Windows Server 2003, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2. Processor Architecture includes x86 (32-bit) and x64 (64-bit)

To install the new driver, double click on “CDM v2.10.00 WHQL Certified.exe”. The file is a setup executable that will automatically install the driver.

4.0 Installing ControlFire® Perforating Panel on Logging Truck

The ControlFire® Perforating Panel would be typically installed in a logging truck as shown in Figure 12. Cabling would be installed in the order listed below:

1. Shooting PWR In Cable, RG8 Coaxial Cable with Cannon Female Plug and Male UHF PL-259 connectors:
 - a. Connect the Male PL-259 connector to Shooting Power Supply output.
 - b. Connect Cannon connector to the Perf Panel, Shooting PWR In.
2. Wire Line Output Cable - RG8 Coaxial Cable with Cannon Male Plug and Male UHF PL-259 connectors:
 - a. Connect Cannon connector to the Perf Panel, Wire Line Output.
 - b. Install the Double Female UHF adaptor on the end of the PL-259 male connector.
 - c. Connect the UHF end of the cable to the truck Wire Line Collector.
3. USB cable:
 - a. Connect one end of cable to a USB input of a PC or Laptop to the Control Panel.
 - b. Connect the other end of the USB cable the USB input of the Perf Panel.
4. AC Input Power Cord:
 - a. Turn both the Power Entry switch and the Safety Key switch to OFF before installing the AC Power Cord.
 - b. Connect the female receptacle to the Perf Panel 120/220 Power Entry connector.
 - c. Plug the AC cord into an AC receptacle of the logging truck.

The Perf Panel is now ready for service. Turn the Power Entry switch to ON and the Safety Key switch to ON. The red light on the Perf Panel should turn on.

Safety: Position ControlFire Panel in truck such that power can be easily disconnected.

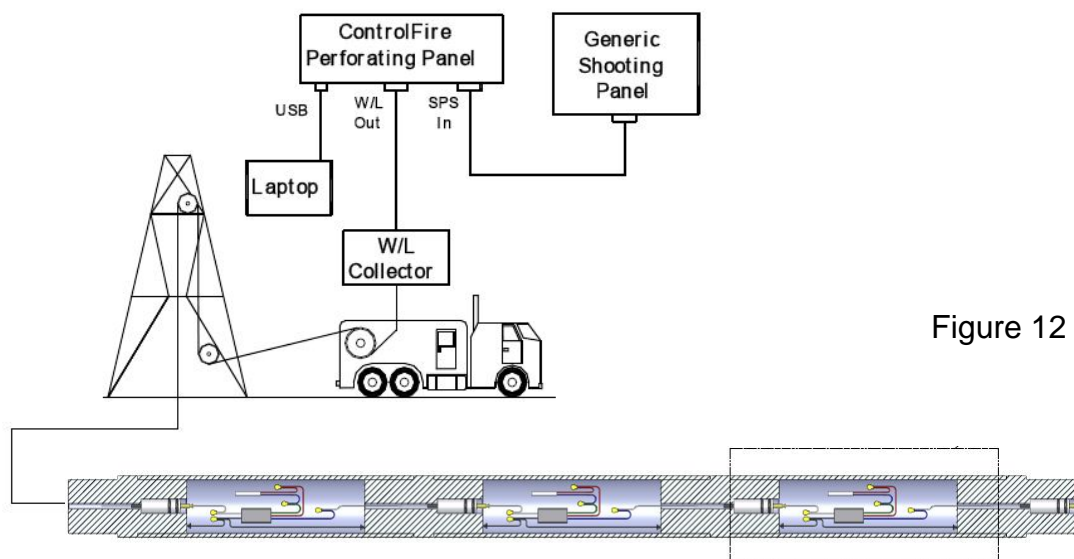


Figure 12

5.0 ControlFire® Operation

The following operation procedures for the ControlFire® are described:

1. Starting the ControlFire® Software
2. Perf Unit Setup for ControlFire® Operations

5.1 Starting the ControlFire® Software

The following steps are required to start the Hunting Titan GUI software

1. Double click the Hunting Titan ControlFire® PU5 icon on your desktop. See Figure 13.



Figure 13

The License Agreement screen appears as shown in Figure 14

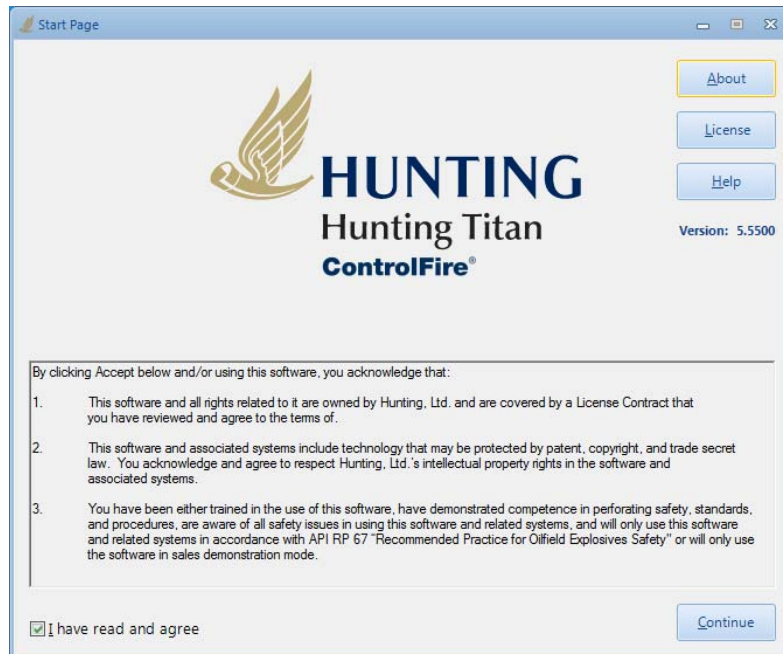


Figure 14

2. Review the About, License, and Help tabs on the ControlFire® Perforating Switch System page and check the **I have read and agree** box and then click **Continue**. The Perf Unit's Serial Port screen will appear after selecting the **Continue** button as shown in Figure 15.

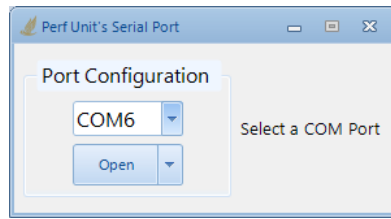


Figure 15

3. Select the appropriate Com port for communication to the Perforating Command and Control Panel and then click **Open**. When reusing the same computer and Perf Unit the Select Perf Unit Com Port screen may not appear and instead the Set-Up screen appears as shown in Figure 16.

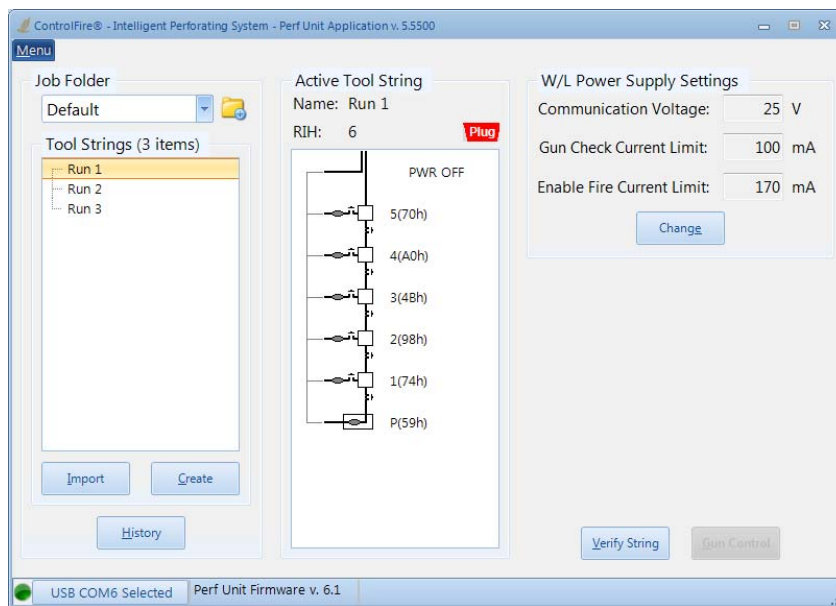


Figure 16

4. The ControlFire® software has now started and the user interface is available with the Perf Unit Set Up screen visible.

Perf Unit Setup Screen Definitions:

Job Folder – A dropdown is used to use an existing job folder.

Import – Activates a previously saved tool string file from another file location.

Create – Generates a new tool string associated with the selected Job Folder.

Menu > Measurement – When selected, user can select between “feet” or “meters” as unit of measurement.

Menu > Delta Current Limits– Do not change default delta current limit values.



Menu > Help – When selected, a ControlFire® User’s Manual is opened for viewing.

Menu > Troubleshooting Guide – When selected, a ControlFire® Troubleshooting guide is opened for viewing.

Menu > Bootloader – When selected, the Bootloader program is executed for updating panel firmware. Refer to the Hunting Bootloader manual for instructions.

Export - Exports the job history for a specified job.

History – Opens a screen to view the history of each run within the job folder. It also enables the user to export specific V/I plots within the job folder.

USB COM Button – Located at the bottom left corner of the status bar, it confirms communication with the Perforating Command and Control Panel via USB cable. The round icon will be displayed in green  **USB COM6 Selected** if communication is enabled and in red  **USB COM6 Selected** if communication is not established.

W/L Power Supply Settings – Enables the user to input the Communication Voltage, the Gun Check Current Limit and the Enable Fire Current Limit.

Verify String – Establishes communication with the tool string and confirms that the tool string created in the software physically matches the actual tool string to be run into the well. Once confirmed the Gun Control button will become enabled.

Gun Control – Changes focus from the job setup screen to the perforating operation interface.

5.2 Setup for ControlFire® Operations

5.2.1 Create New Job Folder

A new Job Folder is normally created for a client on every new job or well. Refer to Figure 17 for the next steps:

1. Click the yellow folder icon and then type in the new name. (For example only, use **Titan Job 1**).
2. Click **OK**. This will create a new job folder, **Titan Job 1**, located in directory: **C:\TitanData\Titan Job 1**.

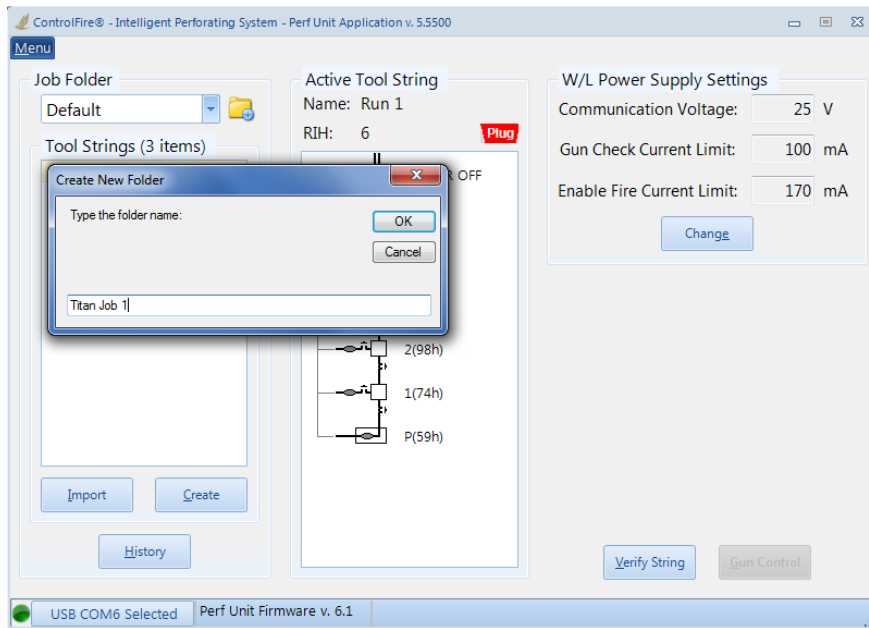


Figure 17

5.2.2 W/L Power Supply Settings

W/L Voltages and Currents settings should remain as default parameters. Default parameters should be adequate for all tools in the string. Refer to the ControlFire Troubleshooting Guide for instances when W/L parameters may need to be changed.

From the setup screen in Figure 17, select the **Change** button in the **W/L Power Supply Settings** group box. This brings up the W/L Information screen shown in Figure 18.

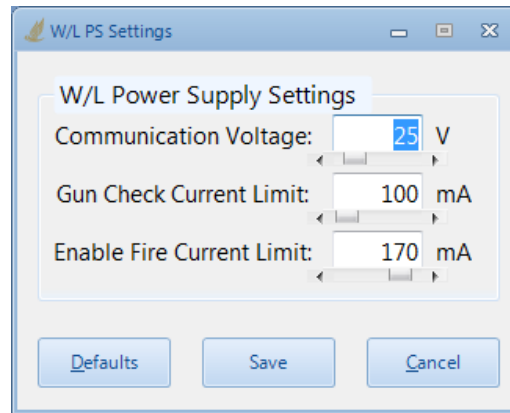


Figure 18

Input the Communication Voltage, the Gun Check Current Limit, and the Enable Fire Current Limit.

Defaults - This loads the default voltage and current values.

Save – New voltage and current values are saved in the current Job Folder.

Cancel – Discards any changes made and returns to the Setup-Up screen.

5.2.3 Create a New Tool String

Perform the following steps to create a new tool string for a specific job folder. (For this example, the Titan Job 1 folder will be used) At this point the user must have the Perforating Command and Control Panel connected to the tool string in order to communicate with the Perf Switches and create a tool string file.

1. Select Titan Job 1 folder (Refer to Figure 17)
2. Click on the **Create** button to create a new tool string. This opens the Create Tool String screen.
3. In rare cases, a 30 second shooting window is required for all guns. If this is the case then also check the **30 Sec Firing Window** box.
4. Use the **Number of Switches** dropdown to select the number of switches in the string as shown in Figure 19.

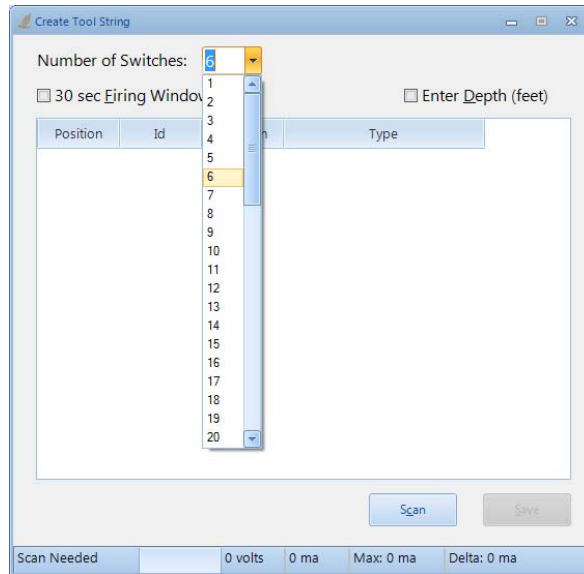


Figure 19

5. Select the **Scan** button. This action will power the wireline and send a sequence of commands from the Perforating Command and Control Panel to the Perf Switches and confirm a functional string.
6. The Switch Unit IDs will be displayed along with the switch revision number in the Create Tool String File window as shown in Figure 20. The number of Perf Switches found must match the number of switches selected. If not, a String Count Mismatch popup occurs and the Scan Tool String must be repeated before the tool string file (file.gsi) can be saved.

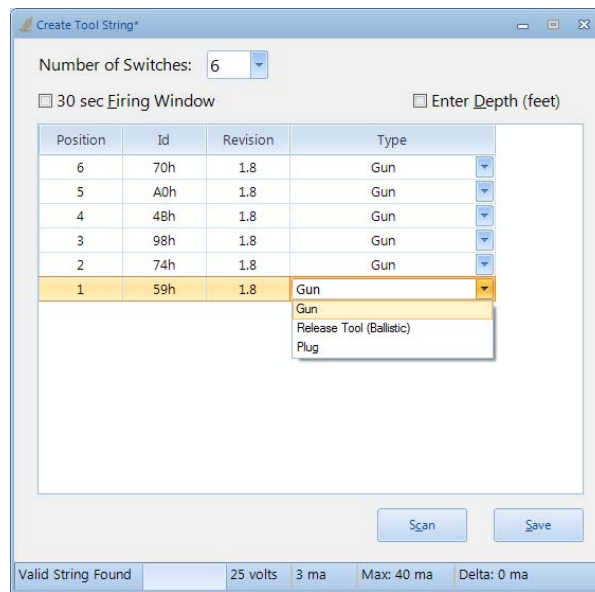


Figure 20

7. The Switch Type can be changed using the dropdown arrow to the right of each switch type. For plug and shoot operations, the bottom switch should be changed to “Plug” as shown in Figure 21. If a ControlFire Safety Sub is in the tool string, the top two switches should be changed to “ControlFire Safety Sub” as shown in Figure 22. If a ballistic release tool is in the tool string, the switch type should be changed to “Release Tool (Ballistic)” at the switch position which it is located in the string as shown in Figure 23.

Figure 21 shows two screenshots of the 'Create Tool String' window. The window has a title bar 'Create Tool String*' and a close button. It contains a 'Number of Switches' dropdown set to 6, a '30 sec Firing Window' checkbox, and an 'Enter Depth (feet)' checkbox. Below these is a table with columns: Position, Id, Revision, and Type. The table has 6 rows. In the left screenshot, the dropdown for Position 1 is open, showing options: Gun, Gun, Release Tool (Ballistic), and Plug. In the right screenshot, the dropdown for Position 1 is closed, and 'Plug' is selected. At the bottom of the window, there are 'Scan' and 'Save' buttons, and a status bar showing 'Valid String Found', '25 volts', '3 ma', 'Max: 40 ma', and 'Delta: 0 ma'.

Position	Id	Revision	Type
6	70h	1.8	Gun
5	A0h	1.8	Gun
4	48h	1.8	Gun
3	98h	1.8	Gun
2	74h	1.8	Gun
1	59h	1.8	Plug

Figure 21

Figure 22 shows two screenshots of the 'Create Tool String' window. The window has a title bar 'Create Tool String*' and a close button. It contains a 'Number of Switches' dropdown set to 6, a '30 sec Firing Window' checkbox, and an 'Enter Depth (feet)' checkbox. Below these is a table with columns: Position, Id, Revision, and Type. The table has 6 rows. In the left screenshot, the dropdown for Position 5 is open, showing options: ControlFire Safety Sub, Gun, Release Tool (Ballistic), and ControlFire Safety Sub. In the right screenshot, the dropdown for Position 5 is closed, and 'ControlFire Safety Sub' is selected. At the bottom of the window, there are 'Scan' and 'Save' buttons, and a status bar showing 'Valid String Found', '25 volts', '3 ma', 'Max: 40 ma', and 'Delta: 0 ma'.

Position	Id	Revision	Type
6	70h	1.8	ControlFire Safety Sub
5	A0h	1.8	ControlFire Safety Sub
4	48h	1.8	Gun
3	98h	1.8	Gun
2	74h	1.8	Gun
1	59h	1.8	Plug

Figure 22

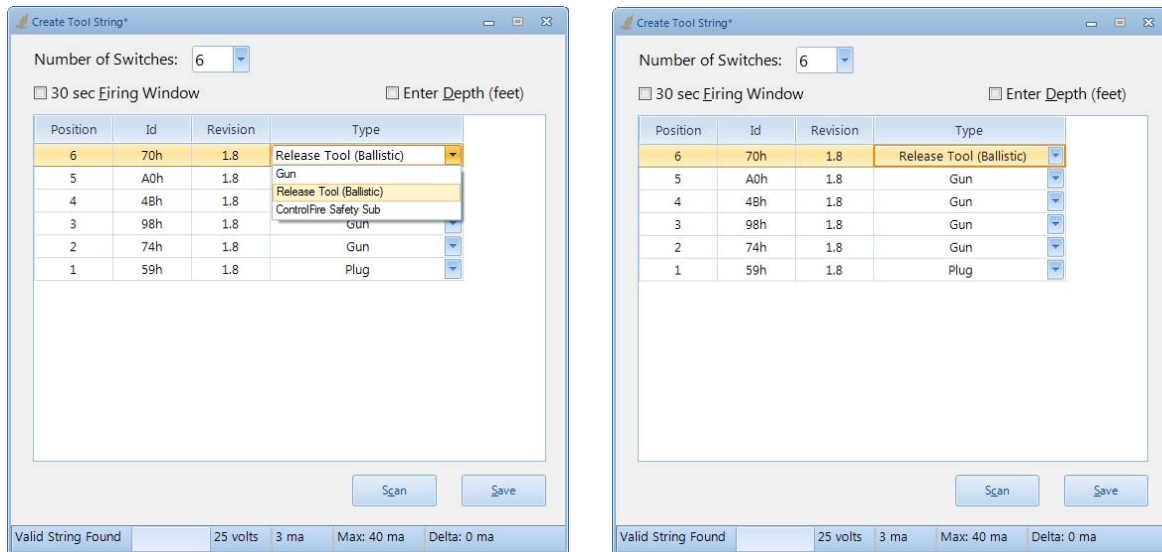


Figure 23

8. The user can enter depth values for correlation purposes by clicking on the “Enter Depth” box. Refer to section 5.2.4 steps 2-4. **This step is optional.**
9. Once the user input and the physical tool string match, select the **Save** button and create the new tool string file. As an example, shown in Figure 24, a Titan Run 1.gsi file was created.

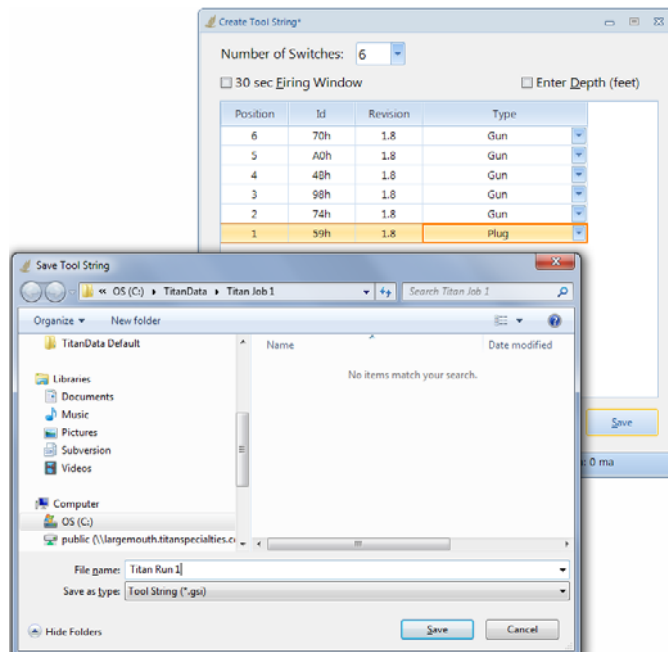


Figure 24

5.2.4 Verify Tool String

After a Tool String File has been successfully created, it is required to verify the tool string. You can also enter depth information if desired.

1. Select the **Verify String** button on the Set Up Screen. The Verify Tool String screen appears and the tool string is validated against the Titan Run 1.gsi file. Following a successful scan the status bar displays “String Validated” as seen in Figure 25

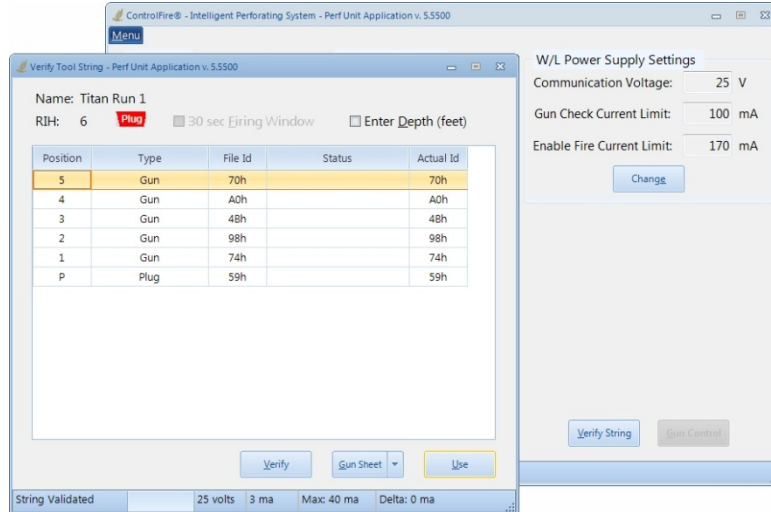


Figure 25

2. If you wish to enter depths for viewing purposes only, select the “Enter Depth” check box. Depth input columns for “Shot Depth”, “CCL/GR Offset” and “Stop Depth” appears as shown in Figure 26. **This step is optional.**

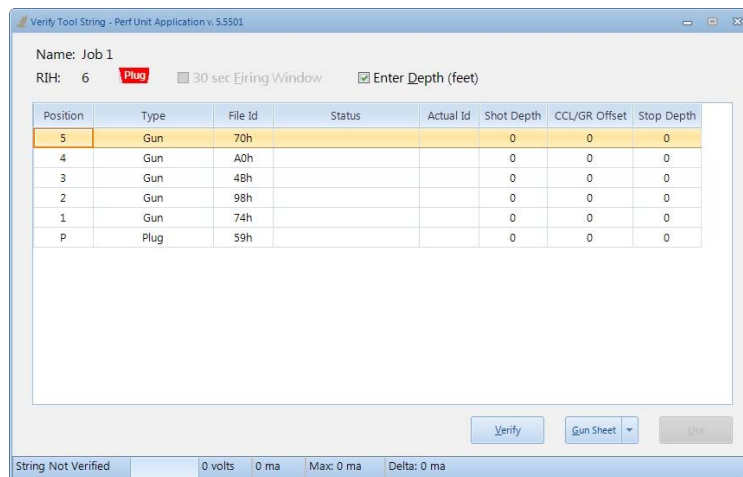


Figure 26

- Enter Shot Depths and CCL/Depth for each item in the tool string. The Stop Depth will automatically populate as shown in Figure 27. **This step is optional.**

Verify Tool String - Perf Unit Application v. 5.5501*

Name: Job 1
 RIH: 6 Plug ☐ 30 sec Firing Window ☒ Enter Depth (feet)

Position	Type	File Id	Status	Actual Id	Shot Depth	CCL/GR Offset	Stop Depth
5	Gun	70h			10000	2	9998
4	Gun	A0h			10100	4	10096
3	Gun	48h			10200	6	10194
2	Gun	98h			10300	8	10292
1	Gun	74h			10400	10	10390
P	Plug	59h			10500	15	10485

Verify Gun Sheet Save

String Not Verified 0 volts 0 ma Max: 0 ma Delta: 0 ma

Figure 27

- Click on the “Gun Sheet” button if you wish to print out a copy of the tool string with depths for correlation purposes. See Figure 28. After saving as a PDF, a gun sheet, as shown in Figure 29, will be available to view and print. **This step is optional.**

Verify Tool String - Perf Unit Application v. 5.5501*

Name: Job 1
 RIH: 6 Plug ☐ 30 sec Firing Window ☒ Enter Depth (feet)

Position	Type	File Id	Status	Actual Id	Shot Depth	CCL/GR Offset	Stop Depth
5	Gun	70h			10000	2	9998
4	Gun	A0h			10100	4	10096
3	Gun	48h			10200	6	10194
2	Gun	98h			10300	8	10292
1	Gun	74h			10400	10	10390
P	Plug	59h			10500	15	10485

Verify Gun Sheet Save

String Not Verified 0 volts 0 ma Max: 0 ma Delta: 0 ma

Save as PDF Save as Excel

Figure 28

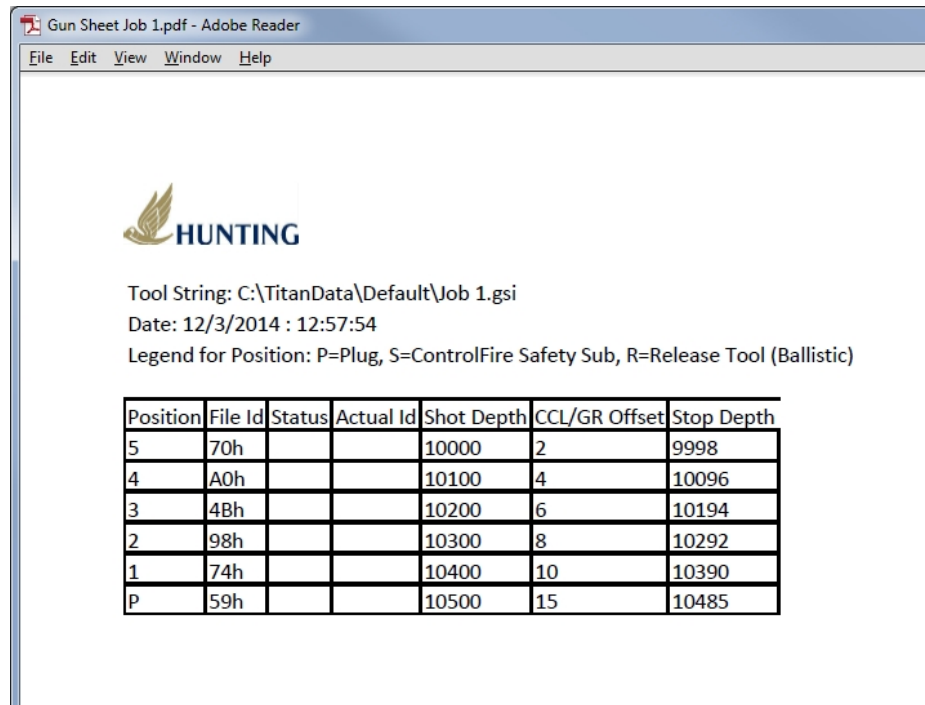


Figure 29

5. Select the **Use** button on the Verify Tool String screen. This action activates the **Gun Control** button on the Set Up screen. See Figure 30.

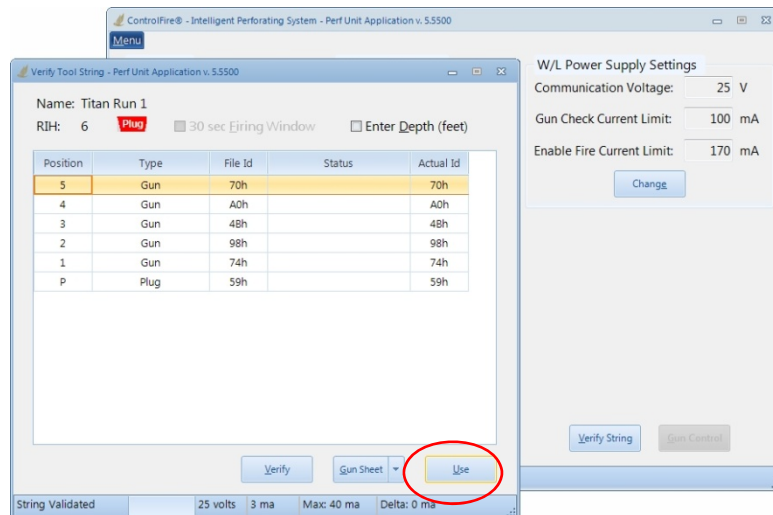


Figure 30

This completes the setup process and a given tool string is ready. The Gun Control screen is now ready for use.

5.3 Gun Check, Arming and Firing

Following a successful Verify, the tool string is ready to begin a Gun Check, Arming and Firing sequence. To start these sequences, select the Gun Control button on the Set Up screen in Figure 31. This activates the Gun Control Screen in Figure 31.

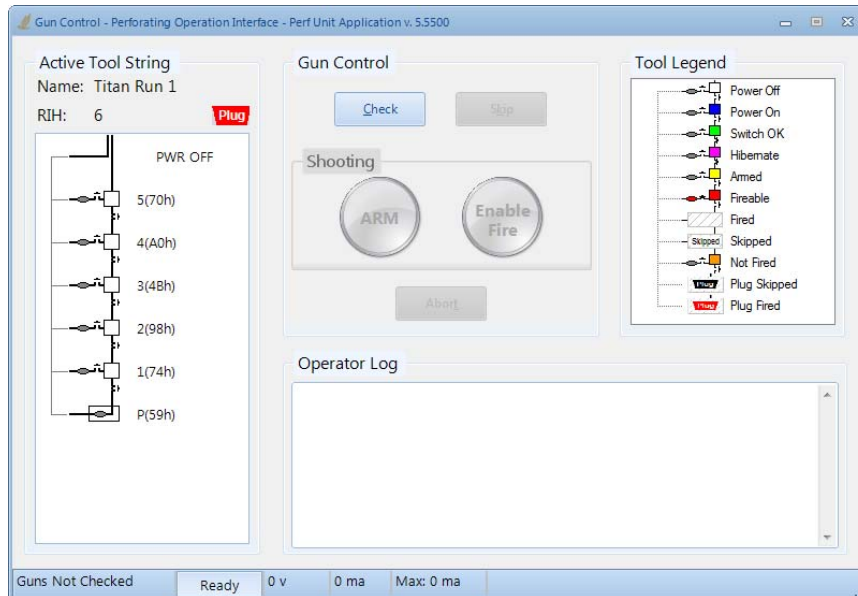


Figure 31

Gun Control Window Definitions:

Warning: All Gun Control commands must be performed in a wellbore at a depth of greater than 200 feet or according to the operator's standards.

Gun Check –The **Check** button requests the Perforating Command and Control Panel to send a set of commands to the Perf Switches and read the status of all the switches in the string. An unlimited number of Gun Check requests can be performed on the tool string. Once the Gun Check is successfully completed, the **Arm** button is accessible to the user.

Arm – Selecting the **Arm** button sends an ARM command to the bottom most active switch. Once the selected gun is armed, the **Enable Fire** button is accessible to the user for 15 seconds. If an enable fire is not sent within a 15 second time window, the Perforating Command and Control Panel will revert back to a pre-initialized gun check screen.

Enable Fire - The **Enable Fire** button commands starts the following sequences:

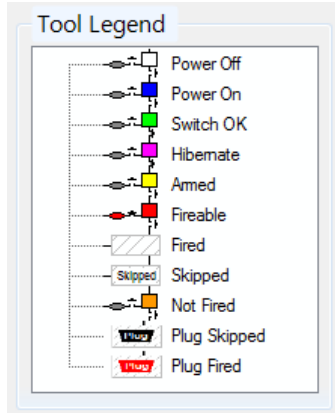
1. The V/I plot appears and immediately starts recording wire line current and voltage. This is used for shot detection.

2. The selected switch connects its detonator to the wire line 4 seconds later in time. The operator must apply (50-60)V onto the wireline before the 4 seconds expire. The reason for this action is to guarantee that the switch string is sufficiently powered when the detonator connects.

Switch Skip – The **Skip** button provides a method to skip over malfunctioned guns. A switch skip command skips the bottom most detected gun in a string. Each additional switch skip command initiated propagates upward one gun.

Abort – The abort button stops the current operation.

Tool Legend – This legend (Figure 32) indicates the state of the switch in the string.



Power Off – No power/communication to switch
Power On – Power applied to switch
Gun OK – Switch verified and operational
Hibernate – Switch is OFF and W/L Switch is ON
Armed – Switch is ready for detonator connection
Fireable – Switch is armed and ready for power to be applied to detonator/igniter
Fired – Enable Fire function has been performed
Skipped – Switch has been skipped and unable to be armed
Not Fired – Enable fire function has been performed but switch remains functional

Figure 32

5.3.1 Gun Check

A Gun Check is initiated by selecting the Gun Check button on the Gun Control Screen. The screen shown in Figure 33 results from a successful gun check.

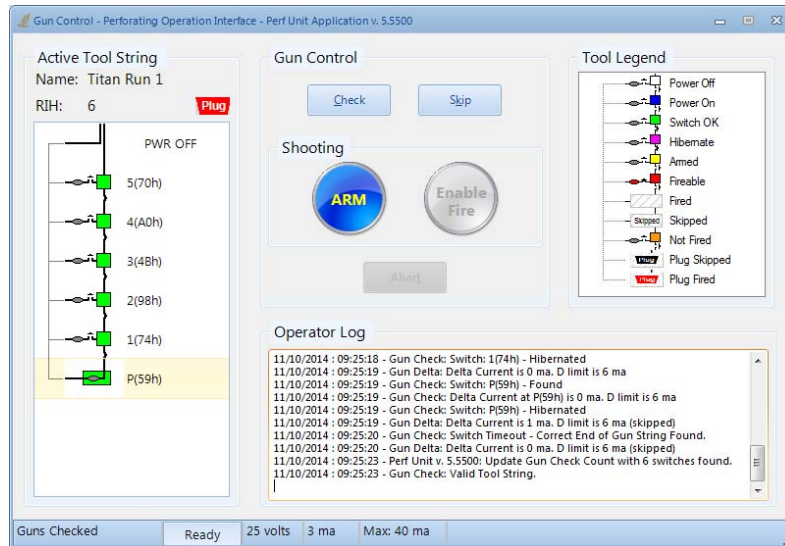


Figure 33

The following indicate a valid gun check:

1. All switch icons are green in color
2. Operator Log does not indicate any errors
3. The status bar displays “Guns Checked”

Shown in Figure 34 is the result of an invalid gun check. For this example, the wire line was not connected between switch (4Bh) and switch (A0h).

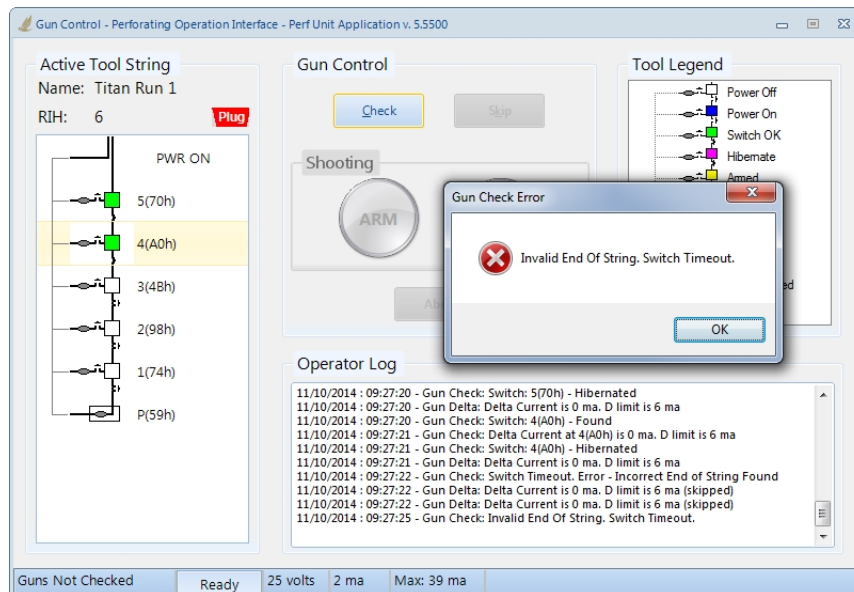


Figure 34

The following would indicate an invalid gun check:

1. Switch icons below the detected error are NOT green in color
2. Operator Log will indicate errors.

5.3.2 Arm and Fire Sequence

Note: Before arming a gun, verify that the depth correlation and tie-in on the perforating correlation software and/or company procedures have been followed.

The **ARM** button becomes active following a successful gun check, see Figure 33. The results of selecting an active **Arm** button are shown in Figure 35.

1. The Icon for the gun to be fired turns Yellow.
2. The Enable Fire button becomes clickable, and the status bar displays “Gun Armed”.
3. A 15 second countdown timer becomes visible indicating the time remaining to select the **Enable Fire** button.

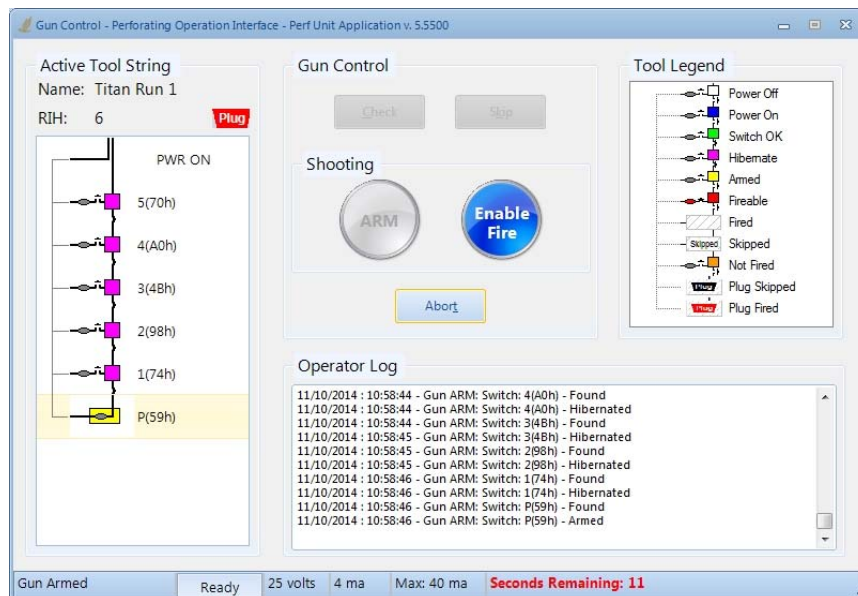


Figure 35

By selecting the **Enable Fire** button in Figure 35, the following results occur as indicated in Figure 36:

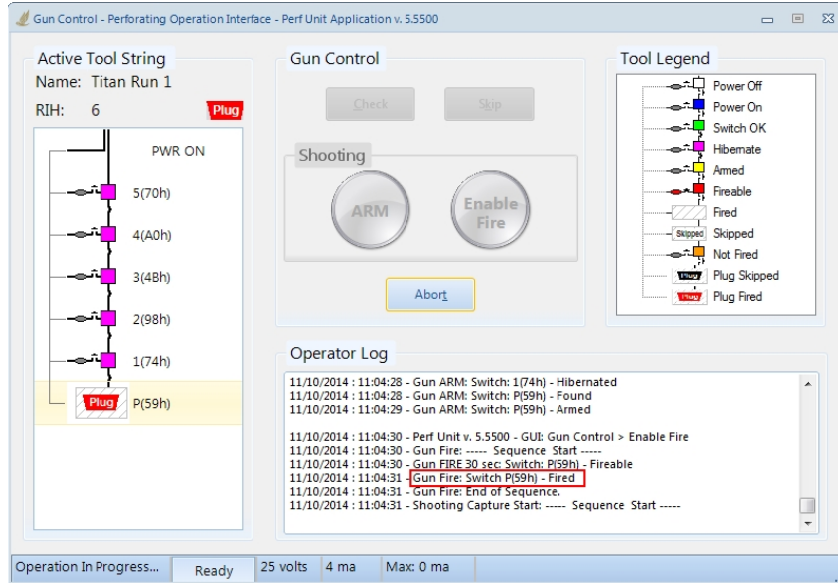


Figure 36

1. The Icon for the gun to be fired changes to a crosshatch image.
2. The Enable Fire button is greyed out.
3. A V/I shot plot appears.

The Shooting Power Supply voltage should be ramped up to supply a sufficient voltage to fire the specific detonator.

An actual real time VI graph is shown in Figure 37 and produces a voltage (blue) and current plot (red) of the applied shooting power and provides a visual aid for shot detection.

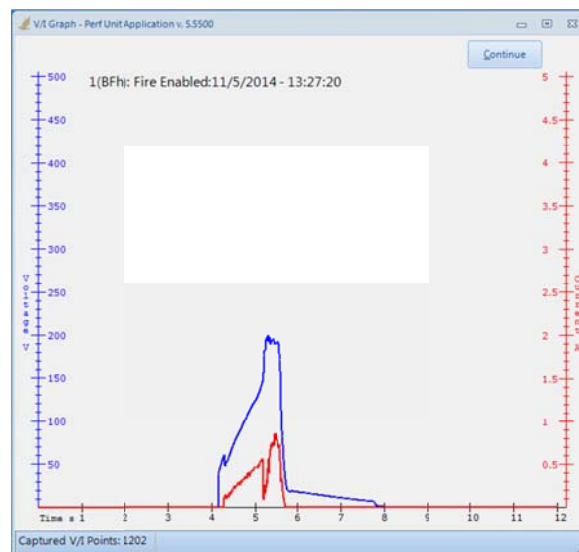


Figure 37

5.4 Gun Skipping Operations

The ControlFire® system allows the user to skip over misfired guns in order to continue perforating operations with the remaining good gun(s). Gun skip operations can be done from two screens:

1. Skip Button in Gun Control Window
2. Verify Tool String Window
3. Right Click in Gun Control Window

5.4.1 Gun Skip using Switch Skip button in Gun Control Window

Guns may be shipped directly from the Gun Control window for active switches in the following situations:

1. The device connected to a switch in the firing sequence is no longer needed for the operation. An example would be to skip a switch in a plug setting operations because the switch remains intact after the plug setting operation is complete.
2. A detonator misfires and the switch remains in communication.

Each time the **Skip** button is selected, the bottom most active switch will be skipped. Once the **Skip** operation is completed, the tool string icons will indicate the skipped gun/plug. Shown in Figure 38 is a resulting gun Check after a Plug has been set. The Plug switch box in the tool diagram will show up as green (switch OK) because the switch remains intact.

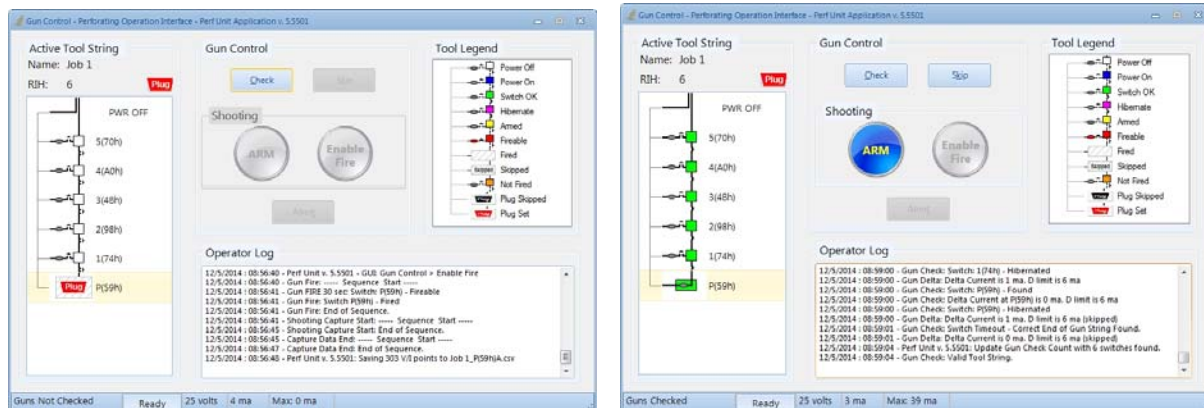


Figure 38

The following steps will allow skipping of the Plug so that Gun 1 is ready for arming.

1. Click on the **Skip** button as shown in Figure 39. A window will appear asking user if they wish to skip the bottom most readable switch, in this case plug switch P(59h). Click “Yes”.

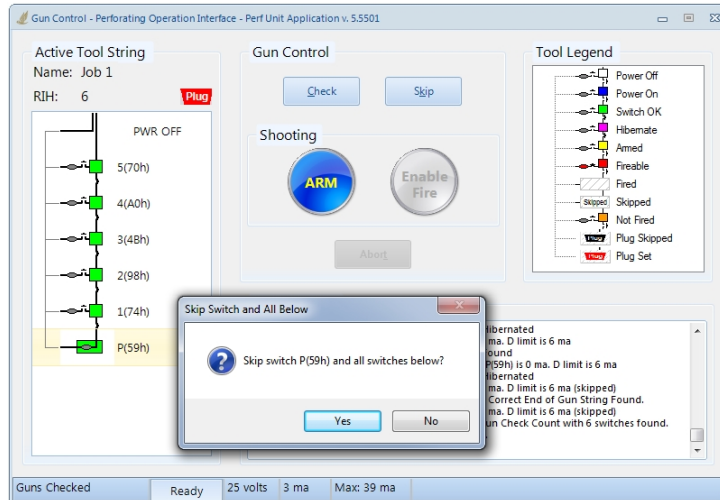


Figure 39

2. A Gun Check will automatically occur resulting in the Plug switch being skipped and Gun 1 switch ready to be armed as seen in Figure 40.

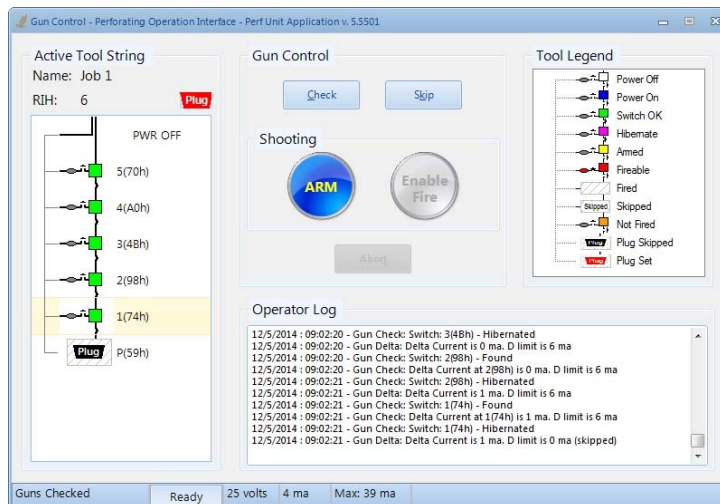


Figure 40

5.4.2 Gun Skip using Verify Tool String Window

In the event that communication of a ControlFire® Switch is lost in the middle of the tool string, it will be necessary to initiate the Gun Skip using the **Verify Tool String** button on the Set Up screen in Figure 25. This event could be caused by broken wires, shorted wires, loss of ground, bad feed-through and etc.

The result of a Gun Check with a disconnected switch is shown in Figure 41 as an example (No communication below switch 4(A0)). In this case the **Skip** button is

not active, and in order skip the Plug and Gun 3, the Verify Tool String screen can be used.

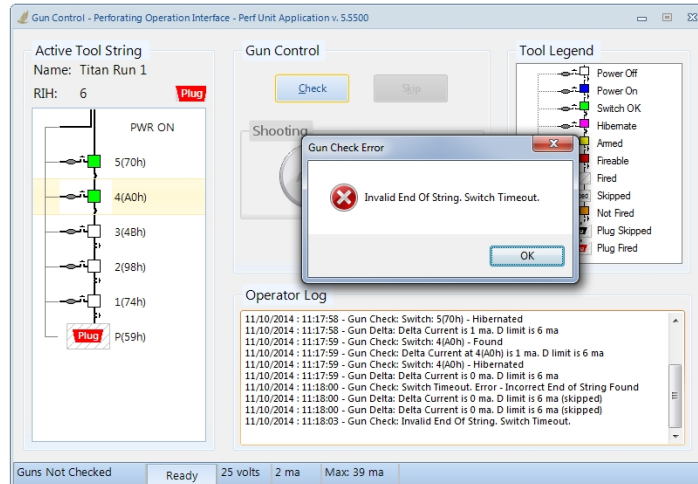


Figure 41

The following steps will allow skipping of the Plug and Gun 1 through 3 in order to fire the top 2 guns:

1. Return to the Perf Unit Setup screen by clicking the icon in the upper right corner of the Gun Control screen.
2. From the Perf Unit Setup screen, select the **Verify Tool String** button. The results of this action are seen in Figure 42.

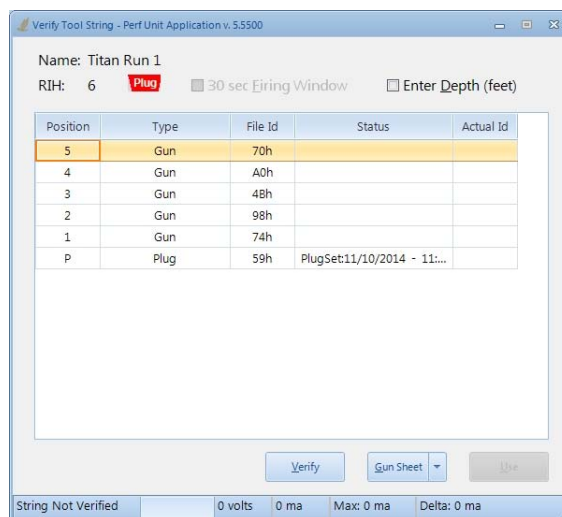


Figure 42

3. Before skipping guns, a Verify should be done to validate the failure. Select the **Verify** button and the results are shown in Figure 43. As seen in Figure 43, this operation confirms the same condition as found on the Gun Control Screen.

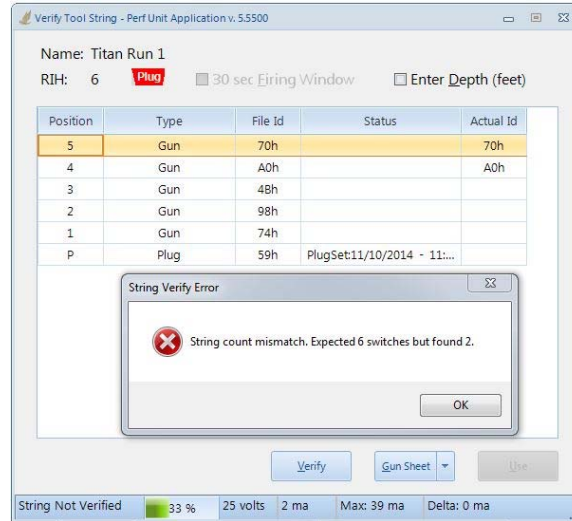


Figure 43

4. The skip operation is accomplished for each gun by right clicking in the Status column and the row of the gun to be skipped. This action opens a dropdown window. Select Skip from the dropdown. For this example, the Plug and Guns 1 through 3 were skipped. The result is seen in Figure 44.

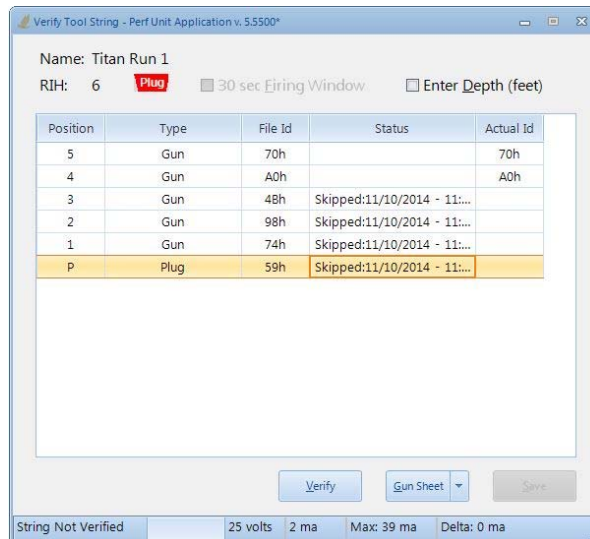


Figure 44

5. Verify the tool string by selecting the **Verify** button. The result of this action is seen on Figure 45. The tool string is again verified.

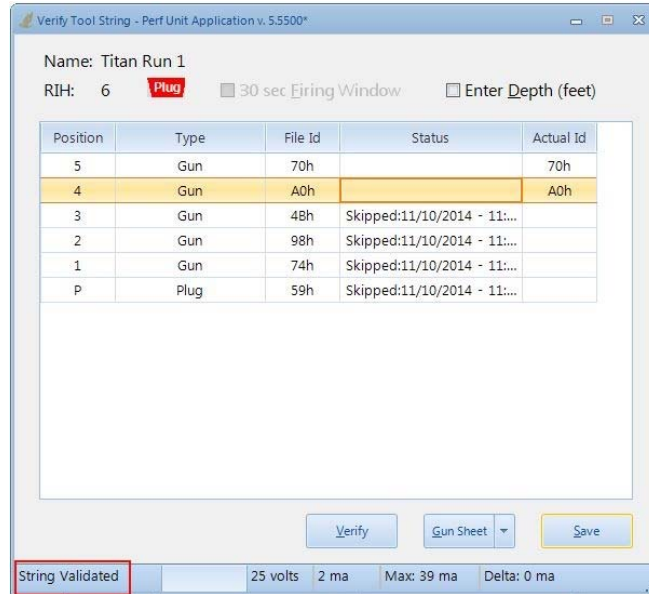


Figure 45

6. Select the **Save** button to return to the Setup screen.
7. From the Setup screen select the Gun Control button to return focus back to the Gun Control screen.
8. Shown in Figure 46 is the result of a successful Gun Check after performing a gun skip on the Plug and the Guns. The tool string can now be used.

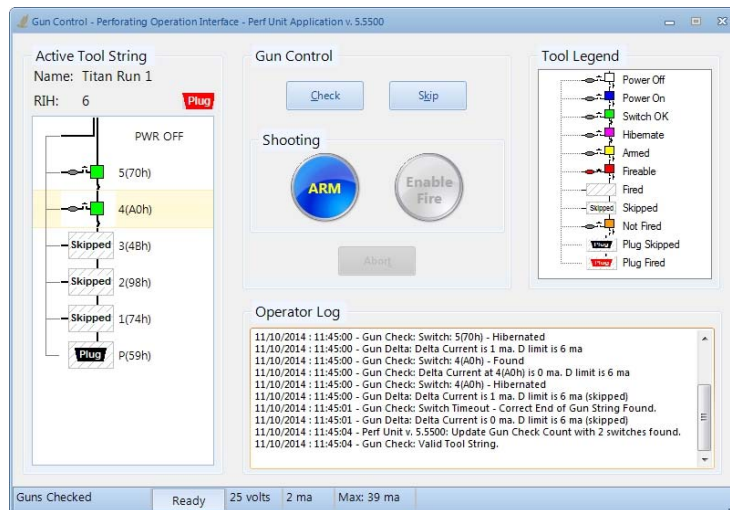


Figure 46

5.4.3 Gun Skip using right click in Gun Control Menu

In the event that communication of a ControlFire® Switch is lost in the middle of the tool string, a Gun Skip can also be initiated by implementing the right click button of your mouse in the Gun Control menu. This event could be caused by broken wires, shorted wires, loss of ground, bad feed-through and etc.

The result of a Gun Check with a disconnected switch (2(97h)) after Gun 1 was successfully fired is shown in Figure 47 as an example. In this case the **Skip** button is not active. You can skip a disconnected switch in this case using the mouse's right click button in Gun Control Menu.

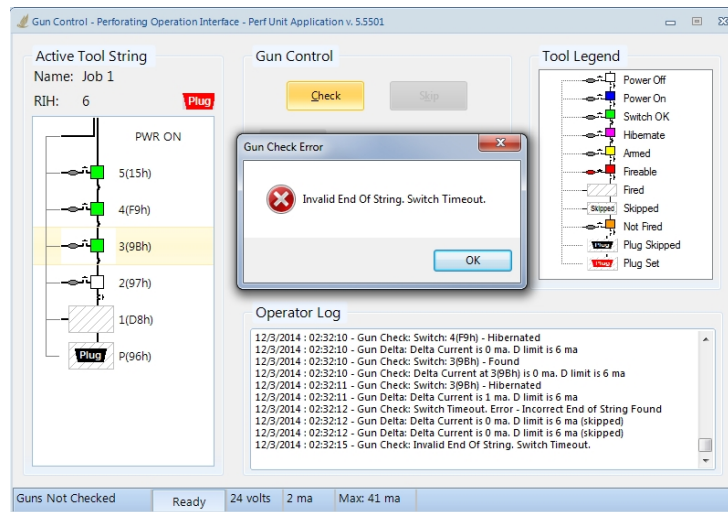


Figure 47

The following steps will allow skipping of Gun 2 such that Guns 3 is ready to arm:

1. Using your mouse, right click on the disconnected switch (2(97h)) in the tool diagram and click "Yes" when the skip switch window appears as shown in Figure 48.

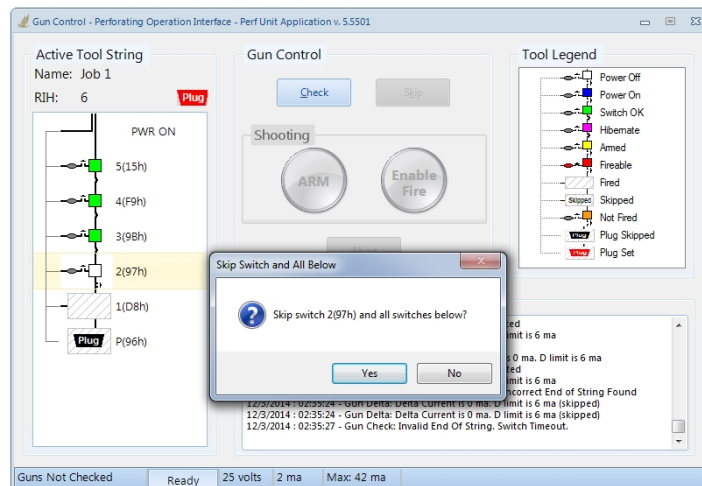


Figure 48

2. A gun Check will automatically occur, resulting in switch 2(97h) skipped and Gun 3 ready to arm as seen in Figure 49.

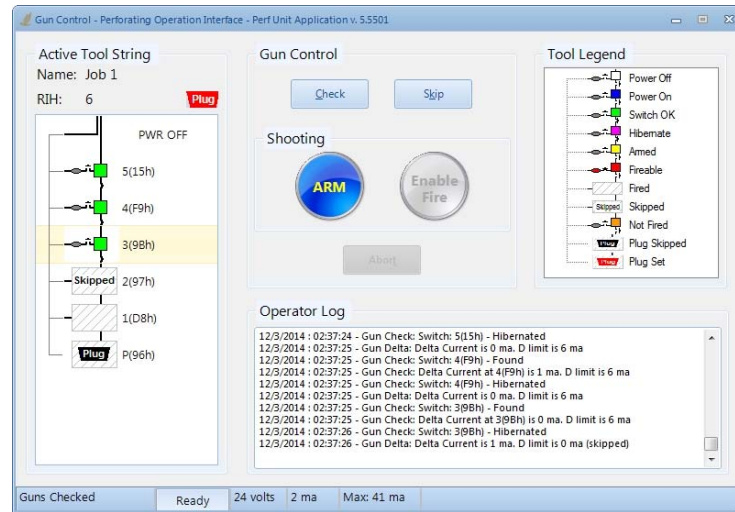


Figure 49

6.0 Cleaning Instructions

There are no user serviceable parts inside the box and the unit does not require any preventive maintenance.

If the unit requires service it must be returned to Hunting Titan.

The unit may be cleaned using a damp cloth to remove and dust and dirt form the case and the metallic faceplate on the inside.

7.0 VeriFire®

The panel shown in Figure 50 is a VeriFire® ControlFire® Switch Tester. The purpose of the VeriFire® panel is to test and confirm the proper operation of ControlFire® switches contained in an armed or unarmed perforating gun while on surface. This unit is self-contained and equipped with a rechargeable battery, built-in touch keys and a sunlight visible LCD. A USB input is also available that supports saving new tool string files and comparing tool strings to existing stored files. It is highly recommended to check the tool string after gun loading, after gun arming and before running in hole using the VeriFire® panel (PN: 9002-013-210). Refer to the *VeriFire® User Manual* for instructions and safe use.



Figure 50

8.0 Gun Loading Instructions

The following procedures are recommendations from Hunting on proper gun loading techniques when implementing ControlFire® switches into perforating gun systems. Only personnel properly trained in ControlFire® operations and explosives handling should load perforating guns containing ControlFire® switches. Refer to API RP 67 Latest Edition for safe practices and standards which must be followed when loading perforating guns.

- **Through Wire Installation:** Run a live wire down the length of the charge tube body as shown in Figure 51. Secure the wire throughout the length of the charge tube body preferably with Teflon tubing (PN: E2500-TTI-S14-1100-NAT) or electrical tape as shown in Figure 52. The ends of the wires should be configured through the openings at each end of the charge tube as shown in Figure 53.



Figure 51



Figure 52



Figure 53

- **Inserting Charge Tube into Gun:** Insert charge tube into gun housing as shown in Figure 54.



Figure 54

- **Connecting Top Sub to Gun:** Connect the live wire coming from the top of the gun to the feed through wire coming from the live pin of the top sub. Attach top sub to gun. Be careful not to pinch wires.
- **Building a Tandem Sub:** It is recommended to use tandem subs with ground screw taps when possible. The tandem sub (PN: 0365-000-389A) should contain an EBFire® gland to fit the EBFire® Feed-Through (PN: 9400-EBTW). Install the EBFire® Feed-Through into the tandem sub. Make sure that the EBFire® Feed-Through sits flush with the bottom of the gland fitting. Install retainer nut (PN: 9400-EBRN 250) into the tandem sub body.
- **Grounding:** ControlFire's electronic communication is bi-directional and requires a better ground than conventional switch systems. Below is a list of grounding techniques in order of most effective to least effective.
 1. Ground to ground wire screw tapped into the sub.
 2. Ground to BOTH a ground wire coming from the above charge tube and a grounding spring in the up-hole end of the sub

(When grounding to the charge tube, a secondary ground such as a grounding spring is highly recommended).
 3. Use a retainer nut with ground (PN: 9400-EBRN-WG) for the tandem sub and run a ground wire along the length of the charge

tube with the live wire to the sub below. Must use EBFire Feed-Through with ground (PN: 9400-EBTW-WG) in tandem sub.

*****The following procedure is the recommended practice when guns are to be armed through the port of the tandem sub. When not arming through the tandem sub port, the ControlFire® switch and detonator must be connected before attaching the tandem sub to gun *****

- **Connecting Tandem Sub to Gun Above:** Feed the detonating cord, live wire and ground wire(s) from the bottom of the gun above through the tandem sub body and out the port of the tandem sub. Attach the tandem sub to the bottom of the gun as shown in Figure 55. Be careful not to pinch wires.



Figure 55

- **Connecting Tandem Sub to Gun Below:** Connect the live wire from the top end of the gun below to the pin on the 9400-EBTW installed in the tandem sub (Refer to Appendix A1 for instructions on attaching wire to EBS pin sub). Attach the gun below to the tandem sub. Be careful not to pinch wires.

*****When implementing the RF-Safe ControlFire® system, the ControlFire® switch is connected during arming. Proceed to Section 9.2 “Arming Instructions for the RF-Safe ControlFire® Assembly” if using the RF-Safe ControlFire® System *****

- **Installing ControlFire® Switch into Tandem Sub:** Connect the white wire from the ControlFire® switch body to the live wire coming from the gun above. Connect the ground wire(s) from both the gun above and sub to the black wire coming from the ControlFire® switch body. Connect the blue wire from the ControlFire® switch body to the white wire from the 9400-EBTW installed in the tandem sub. Figure 56 shows the proper wiring for the ControlFire® switch in a tandem sub. The green and red wires

coming from the ControlFire® switch body should not be connected to the detonator until arming the gun. (Note that the ControlFire® switch body may be black shrink wrap or maroon plastic)

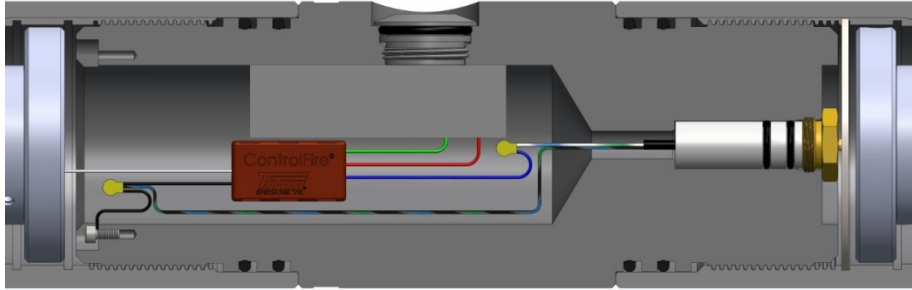


Figure 56

- **Installing ControlFire® Switch into Bottom Gun (No Plug):** Use an Arming Sub (0365-000-366) to house the bottom gun ControlFire® switch when no plug is being run. The bottom nose adapter will connect to the bottom of the Arming Sub. Feed the live wire, detonating cord and ground wire from the bottom gun through the port of the Arming Sub. Attach the Arming Sub to the bottom gun. Be careful not to pinch wires. Through the port of the Arming Sub, connect the white wire from the ControlFire® switch body to the live wire coming from the bottom gun. Connect the ground wire(s) from the bottom gun/sub/ground spring to the black wire coming from the ControlFire® switch body. The blue wire coming from the ControlFire® switch body does not connect to anything but should be terminated to itself. The green and red wires coming from the ControlFire® switch body should be left alone until arming the bottom gun.
- **Installing ControlFire® Switch into Bottom Gun (With Plug):** **FOR PLUG-SHOOT APPLICATIONS, THERE WILL BE TWO ControlFire® SWITCHES BELOW THE BOTTOM GUN: ONE FOR THE BOTTOM GUN AND ONE FOR THE IGNITER TO THE SETTING TOOL.** Both ControlFire® switches may be housed in the tandem sub below the gun. If additional room is needed, an Arming Sub (PN: 0365-000-366) can be run between the bottom gun and tandem sub. Feed the live wire, detonating cord and ground wire from the bottom gun through the port of the Tandem Sub. Attach the Tandem Sub to the bottom gun. Be careful not to pinch wires. Connect the white wire from the ControlFire® switch body to the live wire coming from the bottom gun. Connect the ground wire(s) from the bottom gun or sub body to the black wire coming from the ControlFire® switch body. Connect the blue wire coming from the ControlFire® switch body to the white wire coming from the body of the additional ControlFire® switch (Plug Switch), which is dedicated to the igniter for setting a plug. Ground the black wire coming from the additional ControlFire® switch body to the

same ground as that of the ControlFire® switch above or to the ground coming from the EB feed through below. Connect the green wire from the last ControlFire® switch (Plug Switch) to the live through wire which connects the bulk head (9400-EBTW) going down to the igniter as shown in Figure 57. Cut the blue and red wires of the last ControlFire® switch (Plug Switch). It is recommended to terminate the blue wire so that the end of the blue wire does not come into contact with the sub body. **Do not attach setting tool firing head until ready to arm tool string.**

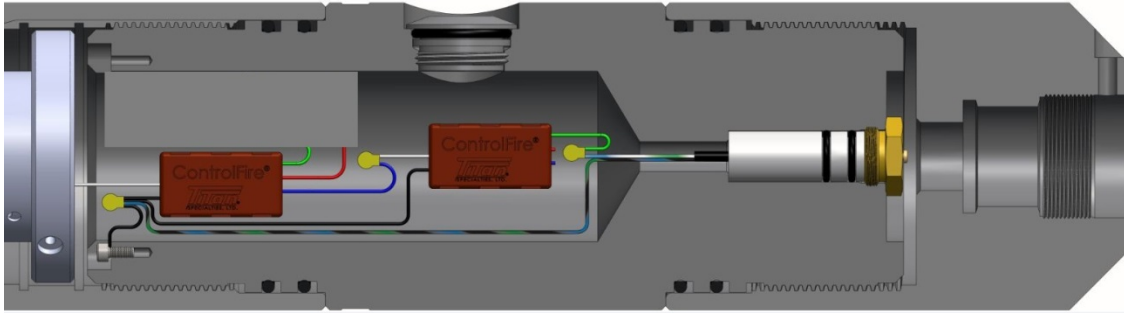


Figure 57

- Attach the Plug Shoot Adapter (PN:0365-000-285) to the bottom of the Tandem Sub. Figure 57 shows a diagram of the proper wiring for plug-shoot applications.
- **Check Tool String with VeriFire® Panel:** It is highly recommended to check the tool string after gun loading using the VeriFire® panel (PN: 9002-013-210). Refer to the *VeriFire® User Manual* for instructions and safe use.

9.0 Arming Instructions

The following procedures are recommendations from Hunting on proper gun arming techniques when implementing ControlFire® switches into perforating gun systems. Only personnel properly trained in ControlFire® operations and explosives handling should arm perforating guns containing ControlFire® switches. Refer to API RP 67 Latest Edition for safe practices and standards which must be followed when arming perforating guns. Table 2 gives the compatible detonators and igniters which can be used to arm perforating guns containing ControlFire® switches.

Normally, it is recommended that the cable head be attached to the tool string before arming the top gun. However, if an additional standard ControlFire switch (without a detonator attached) is in line above the first armed ControlFire® switch, then all guns in the tool string may be electrically and ballistically armed before attaching the tool string to the wireline pending the approval of the operator in charge (Refer to API RP-67).

***The following procedure is the recommended practice when arming guns through the port of the tandem sub. When not arming through the tandem sub port, the ControlFire® switch and detonator must be connected before attaching the tandem sub to gun ***

9.1 Arming Instructions (Non RF-Safe ControlFire® Assembly)

- **Arming Gun Through Tandem Sub:** Secure detonator body into an approved explosives safety tube. It is recommended to always check the detonator resistance using an approved explosives safety multimeter when applicable. Connect the appropriate detonator wire to the red wire of the ControlFire® switch body. Note that the red wire of the ControlFire® switch is ground. Connect appropriate wire of the detonator to the green wire of the ControlFire® switch body. Note that the green wire of the ControlFire® switch is negative voltage input (live wire). Remove detonator body from the explosives safety tube. Attach detonator to detonating cord coming from the above gun. Be careful not to pinch wires when securing arming ports. Figure 58 shows proper tandem sub wiring after arming.

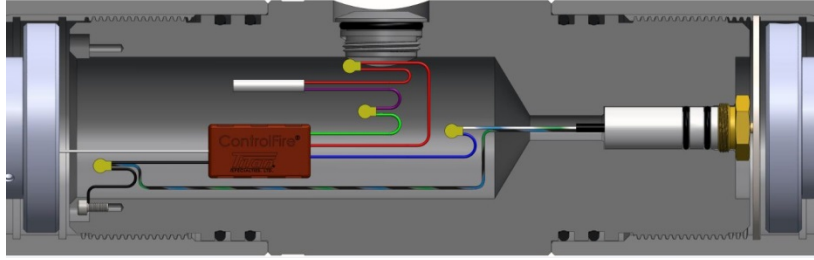


Figure 58

- **Arming Bottom Gun (No Plug):** Wire connections will be made through the port of an Arming Sub. Follow the same arming procedures from “Arming gun through a tandem sub” above. Be careful not to pinch wires when securing bottom sub.
- **Arming Bottom Gun (With Plug):** **THERE SHOULD BE TWO ControlFire® SWITCHES BELOW THE BOTTOM GUN: ONE FOR THE BOTTOM GUN AND ONE FOR THE IGNITER TO THE SETTING TOOL.** Secure detonator body into an approved explosives safety tube. It is recommended to always check the detonator resistance using an approved explosives safety multimeter when applicable. Connect the appropriate detonator wire to the red wire of the ControlFire® switch which is directly attached to the bottom gun. Connect the appropriate detonator wire to the red wire of the ControlFire® switch for the bottom gun. Note that the red wire of the ControlFire® switch is ground. Connect appropriate wire of the detonator to the green wire of the ControlFire® switch for the bottom gun. Note that the green wire of the ControlFire® switch is negative voltage input (live wire). Remove detonator body from the explosives safety tube. Attach detonator to detonating cord coming from the above gun. The green wire from the additional ControlFire® switch (Plug Switch) should be connected to the through wire which connects to the bulk head (9400-EBTW) going down to the igniter as shown in Figure 59. The blue and red wire of the last ControlFire® switch (Plug Switch) should be cut. It is recommended to terminate the blue wire so that the end of the blue wire does not come into contact with the sub body. Figure 59 shows proper wiring when arming for the bottom gun and plug shoot adapter. Attach any adapters and the setting tool firing head which contains a compatible igniter.

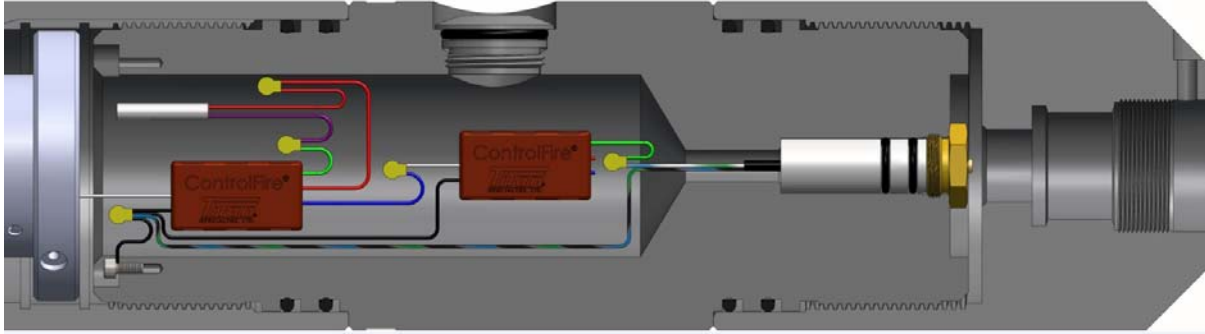


Figure 59

- **Check Tool String with VeriFire® Panel:** It is highly recommended to check the tool string after gun arming using the VeriFire® panel (PN: 9002-013-210). Refer to the *VeriFire® User Manual* for instructions and safe use.

9.2 Arming Instructions for the RF-Safe ControlFire® Assembly

Users of the RF-Safe ControlFire® assembly (PN: DETO-CFA-T) should read the “User Safety and Responsibility” document, which is shipped with each package, prior to using the assembly. It is recommended to always check the detonator resistance using an approved explosives safety multimeter before arming.

***The following procedure is the recommended practice when arming guns through the ports of the tandem subs. When not arming through the tandem sub port, the RF-Safe ControlFire® assembly must be connected before attaching the tandem sub to gun ***

For RF-Safe ControlFire® assemblies which include larger detonators such as the A-85 (PN: DETO-CFA-A85-T), an Arming Sub (PN: 0365-000-366) placed above the EB Tandem Sub should be used. Or a Sliding Window Sub (PN: 0365-000-569A) should be used in place of the Tandem Sub.

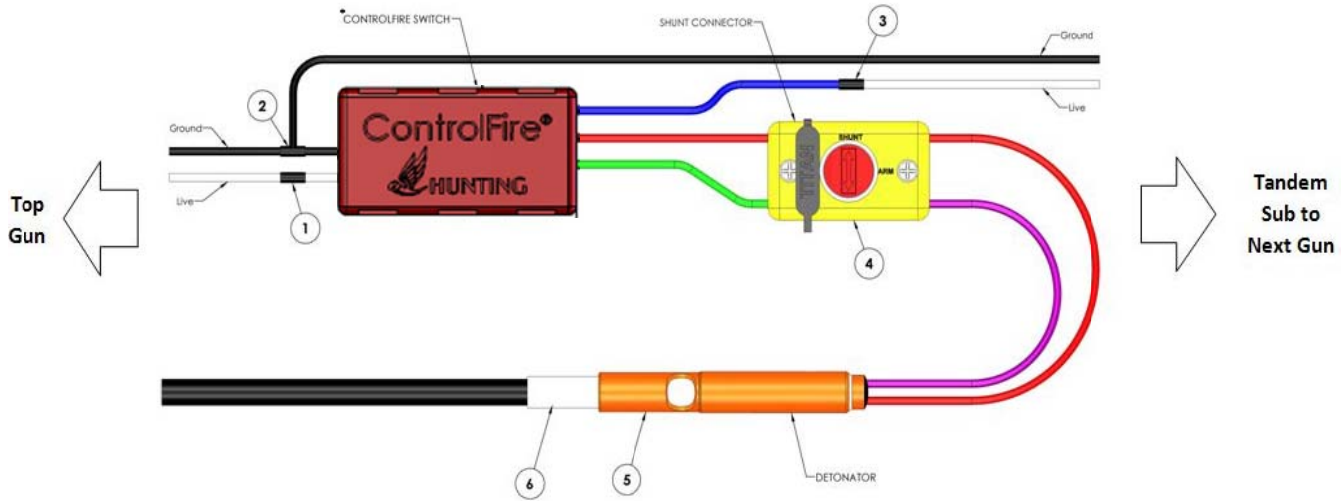


Figure 60

➤ **Arming Gun Through Tandem Sub: Refer to Steps in Figure 60**

1. Connect the live wire from the gun above to the white wire of the RF-Safe ControlFire® assembly.
 2. Connect the ground wires from both the gun above and the tandem sub to the black wire of the RF-Safe ControlFire® assembly.
 3. Connect the live wire from the tandem sub to the blue wire of the RF-Safe ControlFire® assembly.
 4. With the detonator secured in an explosives safety tube, turn the dial of the shunt connector from the “SHUNT” to the “ARM” position.
 5. Remove the detonator from the explosives safety tube.
 6. Connect the detonator to the detonating cord coming from the top gun.
- Be careful not to pinch wires when securing arming ports.

➤ **Arming Bottom Gun (No Plug): Refer to Steps in Figure 60**

Arm the bottom gun using the same steps in the “Arming Gun Through Tandem Sub” section above with the following changes for Steps 2 and 3:

2. Connect the ground wire from the bottom gun / sub body to the black wire of the RF-Safe ControlFire® assembly.
3. The blue wire of the RF-Safe ControlFire® assembly is not connected to anything but should be terminated to itself so that it does not make contact with the sub body.

Be careful not to pinch wires when attaching bottom sub.

➤ **Arming Bottom Gun (With Plug): Refer to Steps in Figure 60**

For plug-shoot applications, a standard ControlFire® switch (Plug Switch) with no detonator attached must be added to the bottom RF-Safe ControlFire® assembly for the igniter of the setting tool. The additional ControlFire® switch designated for the igniter may be housed in a separate adapter such as an Arming Sub (PN: 0365-000-366) between the bottom gun and tandem sub. Use a compatible igniter for the firing head to the setting tool.

Arm the bottom gun using the same steps in the “Arming Gun Through Tandem Sub” section above with the following changes for Steps 2 and 3:

2. Connect the ground wire from the bottom gun / sub body to the black wire of the RF-Safe ControlFire® assembly.
3. The blue wire coming from the RF-Safe ControlFire® assembly will be connected as follows:
Connect the white wire of an additional ControlFire® switch (Plug Switch) to the blue wire of the RF-Safe ControlFire® assembly coming from the bottom gun. Ground the black wire coming from the additional ControlFire® switch body to the same ground as that of the RF-Safe ControlFire® assembly above or to the ground coming from the bulk head below. Connect the green wire from the additional ControlFire® switch (Plug Switch) to the live through wire of the bulk head below (9400-EBTW). Cut the blue and red wires of the last ControlFire® switch (Plug Switch). It is recommended to terminate the blue wire to itself so that the end of the blue wire does not come into contact with the sub body.
Attach the setting tool firing head which contains a compatible igniter. Be careful not to pinch wires.

- **Check Tool String with VeriFire® Panel:** It is highly recommended to check the tool string after gun arming using the VeriFire® panel (PN: 9002-013-210). Refer to the *VeriFire® User Manual* for instructions and safe use.

10.0 ControlFire® Part Numbers

Description	Part Number
ControlFire® Switch System	
V1.8 ControlFire® Switch	9002-013-120-1.8
Command and Control Panel (portable)	9002-013-510
Command and Control Panel (rack mount)	9002-013-550
VeriFire Panel	9002-013-210
Wireline Switch Simulator Panel	9002-013-610
Panel External Test Block	9002-013-320
Cable Kit	9002-013-017
EBFire® Feed Thru	9400-EBTW
EBFire® Feed Thru w/ Ground	9400-EBTW-WG
Retainer Nut – ¼" ID	9400-EBRN-250
Retainer Nut – ¼" ID w/ Ground	9400-EBRN-WG

RF-Safe ControlFire® System (with Austin Powder detonator selection)

RF-Safe Switch with A-85 Detonator	DETO-CFA-A85-T
RF-Safe Switch with A-96L Detonator	DETO-CFA-A96L-T
RF-Safe Switch with A-105 Detonator	DETO-CFA-A105-T
RF-Safe Switch with A-105-100 Detonator	DETO-CFA-A105100-T
RF-Safe Switch with A-140 Detonator	DETO-CFA-A140-T
RF-Safe Switch with A- 140F Detonator	DETO-CFA-A140F-T
RF-Safe Switch with A- 140S Detonator	DETO-CFA-A140S-T

Shooting Power Supply

ControlFire Shooting Power Supply (SPS)	9002-013-810-1
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11.0 User Agreement

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Appendix

A1. EBS Down Hole Pin Wire Attachment

Place a length (1/2" or longer) of white silicone tubing (9400-EBWST) on wire to be attached to switch pin

Strip 3/4" insulation off wire

Start with wire at 90 degrees to downhole pin

Place bare wire in the groove at end of pin, with the end of the insulation touching the pin.

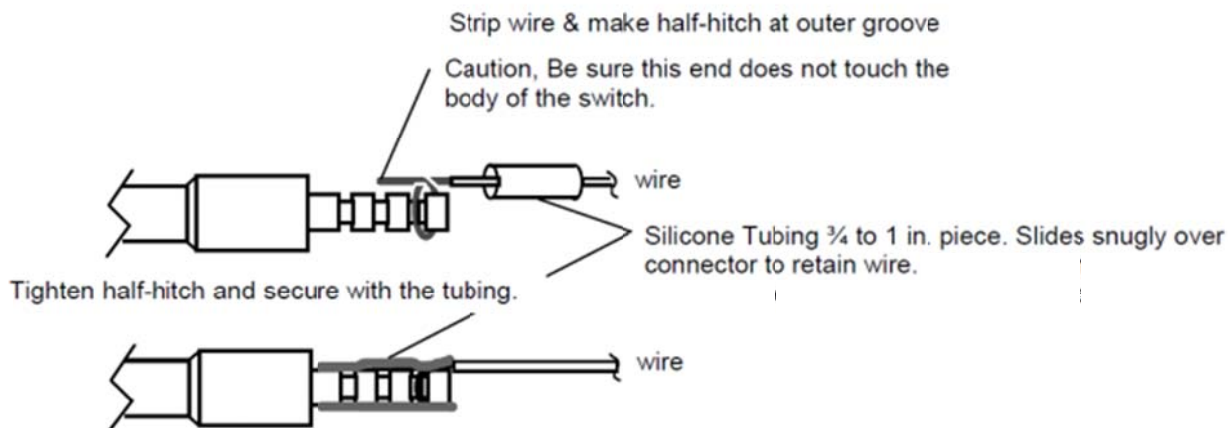
Wrap bare wire around groove in pin one full turn, crossing standing end (the long body) of wire away from the switch body. (downhole side)

Rotate wire 90 degrees such that the long insulated body of the wire is pointing straight downhole and the short bare wire is lying along the length of the pin, pointing at the switch body. Make sure that the bare wire is not long enough to reach the body of the switch and cause a short circuit.

Slide a length (1/2" or longer) of white silicone tubing (9400-EBWST) over the pin and wire, pinning the short bare wire down to the pin.

Done properly, this knot gives the smallest possible profile and is very reliable. Pulled to breaking, it typically breaks below the tie point

A touch of grease on the tubing will help the retainer slide over the tubing if needed



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